Field volatility of Dicamba DGA and S-metolachlor

Report:	MRID 50958202. Ghebremichael, L., S. Grant, A. Gibbs, M. Rebstock, and R. Reiss. Dicamba. Off-target Movement Study of Dicamba (A21472E) Tank-Mixed with Roundup PowerMax Herbicide® and Intact™ - Bootheel Region of Missouri. Final Report. Unpublished study performed by Syngenta Crop Protection, LLC, Greensboro, North Carolina; Lange Research and Consulting, Inc (LRC), Fresno, California; Eurofins EAG Agroscience, LLC, Columbia, Missouri; and Exponent, Inc., Alexandria, Virginia; sponsored by Syngenta Crop Protection, LLC, Greensboro, North Carolina. Report & Task No.: TK0457673. LRC Study No.: LR19452. Eurofins Study No.: Eurofins 89221. Exponent Study No.: 1904443.000 - 5250. Study initiation July 2, 2019, and completion January 9, 2020. Experiment initiation September 9, 2019 (completion date not reported; p. 7). Final Report issued January 9, 2020.
Document No.:	MRID 50958202
Guideline:	OCSPP 835.8100 and 840.1200
Statements:	The study was completed in compliance with U.S. EPA FIFRA GLP standards (40 CFR Part 160) with the exception of statistical analysis, test site information, study weather data, pesticide and crop history, soil information, test plot preparation and maintenance, pH meter maintenance, and sprayer maintenance (p. 3). Signed and dated Data Confidentiality, GLP Compliance, and Quality Assurance statements were provided (pp. 2-5). An Authenticity Certification statement was not provided.
Classification:	This study is **supplemental**. Monitoring started after the conclusion of application. An independent laboratory method validation was not conducted. Offsite plant effects analysis could not be performed due to repeated dicamba injury events. It is uncertain if these types of events continued to occur after the application event, confounding the flux rate estimates.
PC Code:	128931 (Dicamba DGA) and 108800 (S-metolachlor)

Final EPA Reviewer:	Chuck Peck Senior Fate Scientist	Signature: Date:	2020.10.25 05:57:01 -04'00'
Final EPA Reviewer:	Frank T. Farruggia, Ph.D. Senior Effects Scientist	Signature: Date:	2020.10.25 12:41:58 -04'00'
CDM/CSS-Dynamac JV Reviewers:	Richard Lester Environmental Scientist	Signature: Date: 4/28/20	
	Joan Gaidos Environmental Scientist	Signature: Date: 4/28/20	

This Data Evaluation Record may have been altered by the Environmental Fate and Effects Division subsequent to signing by CDM/CSS-Dynamac JV personnel. The CDM/CSS-Dynamac Joint Venture role does not include establishing Agency policies.

Executive Summary

Field volatilization of dicamba in Tavium® Plus VaporGrip® Technology herbicide (A21472E, containing dicamba and S-metolachlor) when tank mixed with Roundup PowerMax Herbicide® (glyphosate potassium salt) and Intact™ (polyethylene glycol, choline chloride, and guar gum) was examined from a single dicamba- and glyphosate-tolerant soybean plot surrounded by non-dicamba tolerant, glyphosate-tolerant soybeans in Scott County, Missouri. Vapor sampling and spray drift deposition sampling were conducted for *ca.* 168 hours following application. Dicamba was applied at a nominal rate of 0.5 lbs. a.e./A. The study also examined off-target movement due to volatility and spray drift. A planned plant effects assessment was not conducted due to repeated symptoms of dicamba injuries observed on the non-tolerant soybeans prior to application for the study.

Air temperatures, surface soil temperatures (i.e., 6 in below surface), and relative humidity the day of application (9/9/19) ranged from 18.5-35.3°C (65.3-95.5°F), 20.1-37.5°C (68.2-99.5°F), and 48-100%, respectively. Air temperatures, surface soil temperatures, and relative humidity ranged from 15.9-39.4°C (60.6-103°F), 19.7-40.4°C (67.5-105°F), and 30-100%, respectively, 1 to 7 days after application.

Under field conditions at the test plot, based on calculations using the Indirect method, study authors estimated a peak volatile flux rate of 0.001239 $\mu g/m^2 \cdot s$ accounting for 0.024% of the applied dicamba observed 4 to 7 hours post-application. By the end of the study, a total of 0.180% of dicamba volatilized and was lost from the field. The reviewer confirmed the peak flux rate and estimated that the total of amount of dicamba volatilized and lost from the field by the end of the study was 0.170%. Peak and secondary peak volatile flux rates occurred during the warm daytime hours each day after application.

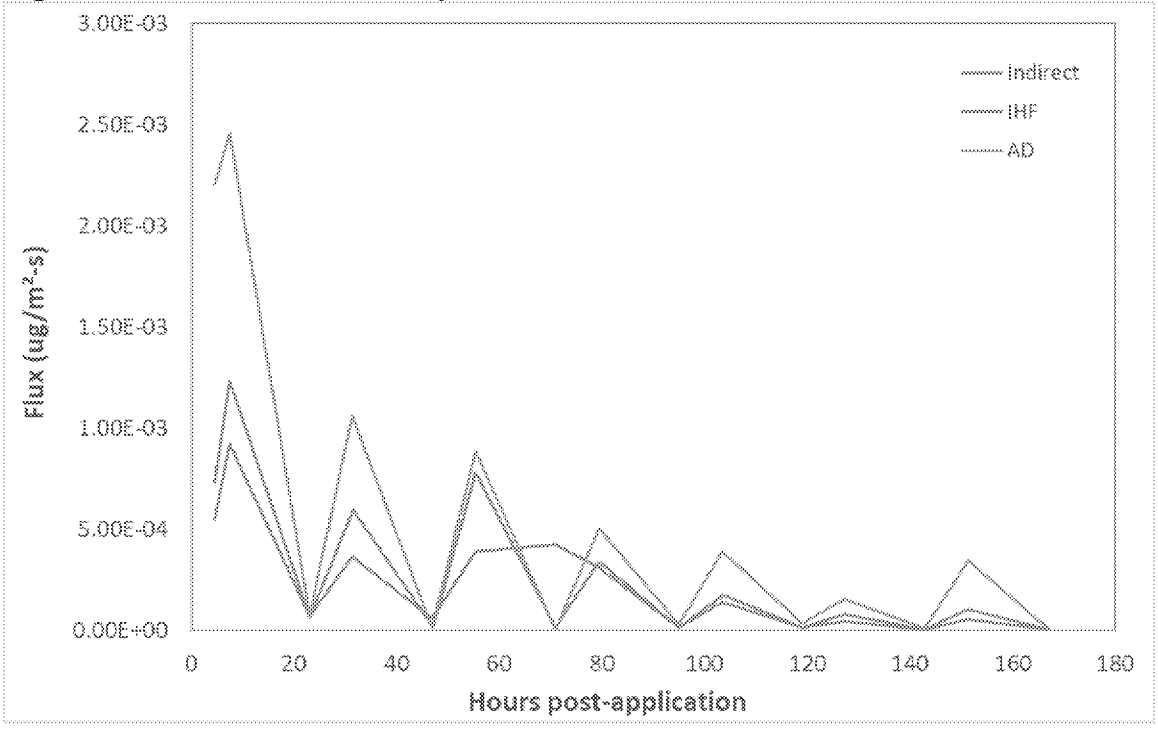
Under field conditions at the test plot, based on calculations using the Integrated Horizontal Flux method, study authors estimated a peak volatile flux rate of 0.001026 $\mu g/m^2 \cdot s$ accounting for 0.027% of the applied dicamba observed 0.0 to 4.0 hours post-application. By the end of the study, a total of 0.153% of dicamba volatilized and was lost from the field. The flux rate estimated by the reviewer for 0.0 to 4.0 hours post-application was different, as the study authors removed the sample collected at the 0.15 m height as an outlier, while the reviewer felt the concentration followed the trend of decreasing concentrations with increasing sampler height. As such, the reviewer estimated the maximum flux for the integrated horizontal flux method, 0.000921 $\mu g/m^2 \cdot s$, which occurred during the second period after application. The reviewer estimated a total of 0.163% of dicamba was lost from the field by the end of the study. Peak and secondary peak volatile flux rates occurred primarily during the warm daytime hours each day after application.

Under field conditions at the test plot, based on calculations using the Aerodynamic method, study authors estimated a peak volatile flux rate of 0.002493 $\mu g/m^2 \cdot s$ accounting for 0.046% of the applied dicamba observed 4.0 to 7.0 hours post-application. By the end of the study, a total of 0.286% of dicamba volatilized and was lost from the field. The reviewer confirmed the peak flux rate and estimated that the total of amount of dicamba volatilized and lost from the field by the

end of the study was 0.303%. Peak and secondary peak volatile flux rates occurred during the warm daytime hours each day after application.

Spray drift measurements indicated that dicamba residues were detected above the no observed adverse effects concentration (NOAEC) in three downwind samples and four right wind samples at one hour after application. Dicamba residues were not detected above the NOAEC in any of the upwind or left wind samples. Dicamba residues were detected at a maximum fraction of the amount applied of 0.00133892 in downwind samples and 0.01118146 in right wind samples. The reviewer estimated a distance from the edge of the field to reach NOAEC for soybeans ($2.6x10^{-4}$ lb ae/A, or a deposition fraction of $5.2x10^{-4}$) of 3.5 (1 to 4.8 m for the three transects) and 10.6 m (4.5 to 17 m for the two transects) in the downwind and right wind directions, respectively, for the first hour after application. The study authors did not perform fits of spray drift data, determining that they would not be useful due to the low levels of dicamba mass detected in the majority of samples.

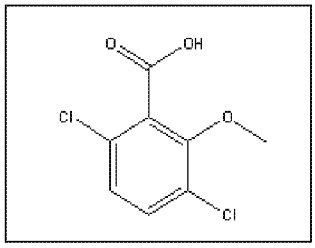
Figure 1 Volatile Flux – Soybean Plot



The effect of **A21472E (a.i. Dicamba diglycolamine (DGA) salt + a.i. S-Metolachlor) + Roundup PowerMax Herbicide® (a.i. Glyphosate potassium salt) + Adjuvant Intact™** on the vegetative vigor of dicot (soybean, *Glycine max)* crops in Scott County, Missouri was to be studied in a spray drift and volatilization study at a nominal rate of 0.5 lb ae/A. However, before test substance application, the dicamba-non-tolerant soybean in the test plots displayed symptoms of dicamba (auxin-type) injuries. Soybean were replanted and auxin-type injuries were observed in the re-planted stand. The repeated observations of plant injuries in dicamba-non-tolerant soybean prior to the planned application compromised the key aspect of plant effects evaluations and made it unfeasible to collect meaningful data for the intended study purpose; therefore, the decision was made not to perform the plant effects assessments.

I. Materials and Methods

A. Materials



1. Test Material

Product Name: A21472E (Tavium® Plus VaporGrip® Technology; p. 20)
Formulation Type: Capsule suspension
CAS #: 104040-79-1 (dicamba diglycolamine salt)
CAS #: 87392-12-9 (S-metolachlor)
Lot Number: Batch ID 1087560, Other ID HDM9D25081
Storage stability: The recertification date of the test substance was May 31, 2022.

Product Name: Roundup PowerMax® (Glyphosate, (N-(phosphonomethyl) glycine potassium salt; p. 21)
Formulation type: Not reported
CAS Number: Not reported
Lot Number: MXZT1109AJ
Storage stability: The expiration date of the test substance was July 18, 2020.

Product Name: Intact (polyethylene glycol, choline chloride, guar gum)
Formulation type: Not reported
Lot Number: 0941B047000 (Batch# 374-25)
Storage stability: The expiration date of the test substance was July 19, 2022.

2. Storage Conditions

The test substance was received by Lange Research and Consulting, Inc. (LRC) on July 2, 2019 and stored ambiently at the LRC facility and at the test site (Appendix I, p. 82). There were periods when the temperature was above the recommended storage temperature of 86°F. Average storage temperature was 79.8°F. Tank mix partners were acquired from commercially available sources and delivered directly to the field site. The tank mix was prepared, and the test substance sprayed on the test plot on September 9, 2019.

B. Study Design

1. Site Description

The test site was in Scott County, Missouri, in the Bootheel region of Missouri (p. 12). A single soybean plot, measuring *ca.* 840 ft × 944 ft (256 m × 288 m, 18.2 A) was treated with a mixture of A21472E (containing dicamba and S-metolachlor), Roundup PowerMax Herbicide® (containing glyphosate potassium salt), and Intact™ (polyethylene glycol, choline chloride, and

guar gum; pp. 20-21). The soybean plot was planted with dicamba- and glyphosate-tolerant soybeans (Variety: P48A60X) and surrounded by a *ca.* 300-ft buffer planted in non-dicamba tolerant, glyphosate-tolerant soybeans (Variety: GSG 4914). Soil characterization indicated the USDA textural class was loamy sand (Appendix I, p. 99). Dicamba had not been applied to the test plot in the three years preceding the study (Appendix I, Appendix 4, p. 141). The plot was at least 1,000 feet away from other dicamba applications (p. 12). Crop history for the three years preceding the study indicated the field had been planted in corn, wheat, soybeans, and popcorn. Terrain was flat with a slope of 0-1% (p. 21). The test plot was surrounded primarily by agricultural land (Appendix I, Figure 2, p. 118). The test plot and surrounding buffer zone were planted with soybean on July 8, 2019 and replanted on August 9, 2019 due to injuries symptomatic of dicamba damage (Appendix I, pp. 80-81). The soybean seeds were planted at a density of 180,000 seeds/A on 15-inch row spacing for both plantings. The seeds received a seed treatment of Revise SB prior to planting.

2. Application Details

Application rate(s):	The target application rate was 0.5 lb a.e./A or 15 GPA (p. 12; Appendix I, p. 90). Twelve application monitoring samples consisting of four filter paper samples each were positioned in the spray area in locations to capture various portions of the spray boom (Appendix I, pp. 92-93). The spray rate was automatically maintained by variable flow rate technology (Appendix I, p. 92). Actual application pass times were 129.0% of the target application pass time (Appendix I, Table 4, p. 107). Variable flowrate technology ensured sprayer output of 15 GPA.
Irrigation and Water Seal(s):	No irrigation or water seals were reported in the study. No precipitation occurred September 9-16, 2019 during the field volatility study (Appendix I, Table 9, p. 112).
Tarp Applications:	Tarp use was not reported in the study.
Application Equipment:	A self-propelled RoGator 1100C sprayer equipped with a 1,100-gallon tank, 119.2-ft boom, and 143 Turbo TeeJet® Induction (TTI) 11004-VP nozzles was used for the spray application (Appendix I, p. 91). The nozzles were installed with 10-inch spacing, and the boom height was set at 36 inches above the crop canopy (soybeans were 12 in [30.5 cm] in height at time of application). According to the label, applications are to be made "not more than 24 inches above the target."
Equipment Calibration Procedures:	Nozzle uniformity was tested by spraying water at a pressure of 63 psi through the boom and measuring nozzle output using SpotOn® Model SC-1 sprayer calibrator devices (Appendix I, p. 92). Each

nozzle was tested three times to determine variability. Calibration of the sprayer and nozzles established the total boom output per minute of spray to be 238.90 LPM (liters per minute).

Application Regime: The application rates and methods used in the study are summarized in **Table 2**.

Table 2. Summary of application methods and rates for dicamba

Field	Application Method	Time of Application (Date and Start Time)	Amount Dicamba Applied[1] (lbs)	Area Treated (acres)	Calculated Application Rate[2] (lb ae/acre)	Reported Application Rate (gal/acre)
Soybean	Spray	9/9/2019 at 9:38	9.1	18.2	0.5	15

Data obtained from Appendix I, pp. 86, 91, 98 and Appendix I, Table 5, p. 108 of the study report.
[1] Reviewer calculated as application rate (lb a.e./acre) × area treated (acres).
[2] The target application rate of 0.5 a.e./acre is reported. The study does not calculate an actual application rate.

Application Scheduling: Critical events of the study in relation to the application period are provided in **Table 3**. Application to the soybeans occurred at the R1 stage, while the intended application was to occur at the V4 stage.

Table 3. Summary of dicamba application and monitoring schedule

Field	Treated Acres	Application Period	Initial Air/Flux Monitoring Period[1]	Water Sealing Period	Tarp Covering Period
Soybean	18.2	9/9/2019 between 9:38 – 9:54	9/9/2019 between 10:06 – 14:09	Not Applicable	Not Applicable

Data obtained from Appendix I, p. 86; Appendix I, Table 5, p. 108; and Appendix III, Table 2, p. 464 of the study report.
[1] Initial air monitoring period is that for perimeter stations. The initial period at the center station was 9/9/2019 between 10:07 – 14:10 (Appendix III, Table 4, p. 468).

3. Soil Properties

Soil properties measured before the study are provided in **Table 4**. pH of the soil was 6.3 (Appendix I, Appendix 3, p. 138).

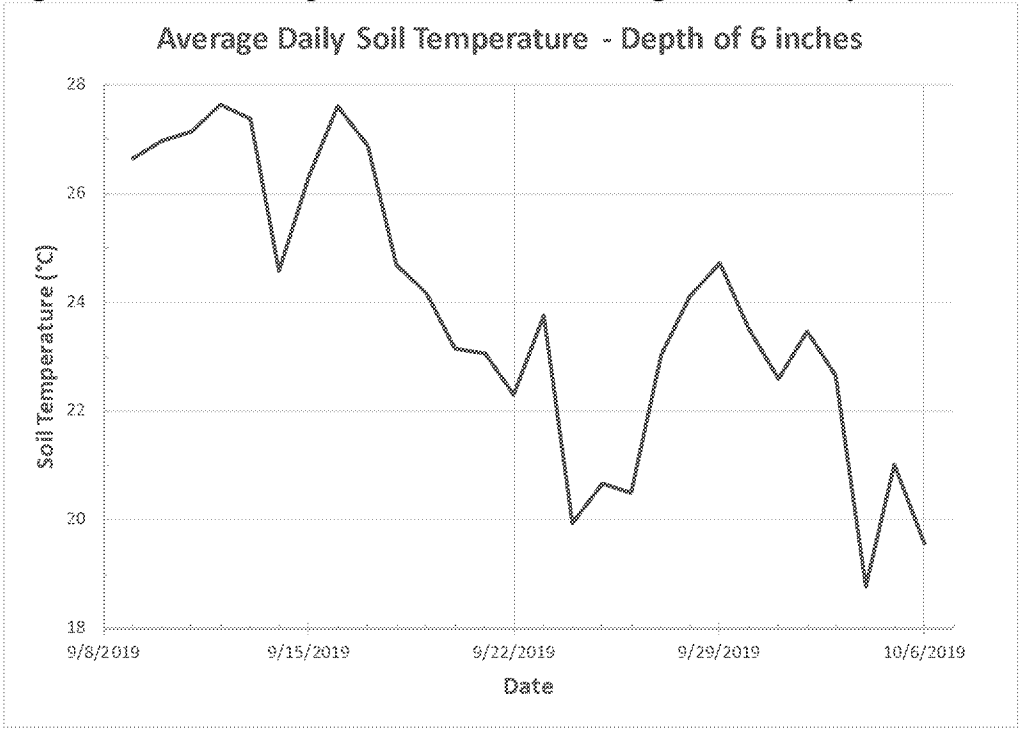
Table 4. Summary of soil properties for the soybean plot

Field	Sampling Depth (inches)	USDA Soil Textural Classification	USGS Soil Series	WRB Soil Taxonomic Classification	Bulk Density (g/cm^3)	Soil Composition
Soybean	0-6	Loamy sand	Clana loamy fine sand and Diehlstadt sandy loam	Not Reported	1.29	% Organic Carbon[1] = 0.87% % Sand = 86% % Silt = 7% % Clay = 7%

Data obtained from Appendix I, pp. 85, 99 and Appendix I, Appendices 2-3, pp. 135-138 of the study report.
[1]Reviewer calculated as: organic carbon (%) = organic matter (%)/1.72. Organic matter was reported as 1.5%.

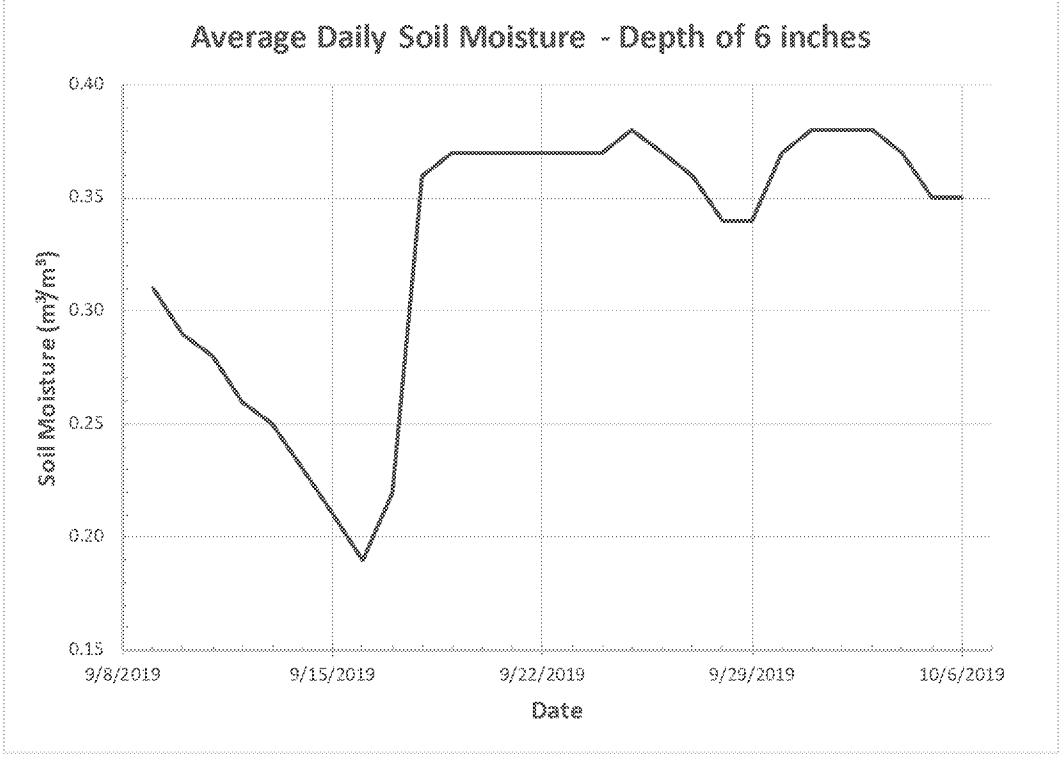
Figures 2 and **3** are plots of soil temperature and soil moisture measured throughout the study.

Figure 2 Soil temperature measured throughout the study



Data obtained from Appendix I, Table 10, pp. 114-115 of the study report.

Figure 3 Soil moisture measured throughout the study



Data obtained from Appendix I, Table 10, pp. 114-115 of the study report.

4. Source Water

The source of the tank mix water was a rural surface water supply. The pH of the tank mix water was 8.2 as measured at the analytical laboratory, an alkalinity of 92 mg $CaCO_3$/L, and a conductivity of 0.30 mmhos/cm.

5. Meteorological Sampling

Five meteorological stations were used to collect weather data during the study (Appendix I, p. 88).

The 10-meter main meteorological station was located upwind *ca.* 225 feet south of the test plot (Appendix I, p. 88). The system included a Campbell CR1000X Datalogger and a Campbell Scientific 4G Cellular Modem to remotely monitor data. The station included sensors for monitoring windspeed and direction, air temperature, relative humidity, solar radiation, and precipitation. Windspeed and direction, air temperature, and relative humidity were reported at heights of 1.7, 5, and 10 m above the ground. Solar radiation and precipitation were reported at the ground surface (Appendix III, Table 1, p. 460).

A boom height anemometer collected wind speed and wind direction data *ca.* 25 feet downwind of the treated plot edge during application at a height of 20 inches above the crop canopy (crop canopy 12 in, 30.5 cm, at application, Appendix I, pp. 87-89). The sensor measured every second and summarized results every one minute and every two minutes.

The long duration main meteorological station was located outside of the application area *ca.* 300 feet north of the treated area border and recorded data for 28 days post-test substance application (Appendix I, pp. 87, 89). The station included one Campbell Scientific ClimaVUE sensor which measured wind speed and direction, air temperature, relative humidity, solar radiation, precipitation, and barometric pressure. The sensor was located at a height of 1.5 m. A Campbell Scientific soil moisture/temperature sensor measured soil moisture and soil temperature at a depth of 0-6 inches (Appendix I, p. 85 and Appendix I, Table 10, pp. 114-115).

The primary flux meteorological station was deployed outside of the plot prior to application and was then moved to the center of the plot, remaining there until after the final drift sample was collected on the morning of September 16, 2019 (Appendix I, p. 89). The station included a Campbell CR1000X Datalogger and a Campbell Scientific 4G Cellular Modem to remotely monitor data. The station included sensors for air temperature, wind speed, and wind direction at heights of 0.15, 0.33, 0.55, 0.9, and 1.5 m above the crop canopy.

A secondary flux meteorological station located upwind and outside the sprayed area also recorded air temperature, wind speed, and wind direction at heights of 0.15, 0.33, 0.55, 0.9, and 1.5 m above the canopy (Appendix I, pp. 89-90).

Due to an instrument malfunction, data were only recorded at the secondary flux meteorological station during the period September 9-13, 2019. Data were not recorded for September 13-16,

2019. Because the secondary flux meteorological station was a backup to the primary flux meteorological station, the missing data had minimal impact on the study.
Details of the sensor heights and the meteorological parameters for which data were collected are illustrated in **Table 5**. The location of the meteorological equipment is shown in **Attachment 3**.

Table 5. Summary of meteorological parameters measured in the field

Field	Minimum Fetch (m)	Parameter	Monitoring heights	Averaging Period
Soybean 10-Meter Main Met. Station	Not Reported	Air temperature	1.7, 5, and 10 m above ground surface	1 minute
		Relative humidity		
		Wind speed/wind direction		
		Precipitation	Ground surface	
		Solar radiation		
Soybean Boom Height Anemometer	Not Reported	Wind speed/wind direction	20 in. above canopy	1 minute and 2 minutes
Soybean Long Duration Main Met. Station	Not Reported	Air temperature	1.5 m above ground surface	Not Reported
		Relative humidity		
		Wind speed/wind direction		
		Precipitation		
		Solar radiation		
		Barometric pressure		
		Soil temperature	0-6 inches depth	1 hour
		Soil moisture		
Soybean Primary Flux Met. Station	Not Reported	Air temperature	0.15, 0.33, 0.55, 0.9, and 1.5 m above canopy[1]	1 minute
		Wind speed/wind direction		
Soybean Secondary Flux Met. Station	Not Reported	Air temperature	0.15, 0.33, 0.55, 0.9, and 1.5 m above canopy[1]	1 minute
		Wind speed/wind direction		

Data obtained from Appendix I, pp. 85, 87-90, Appendix III, pp. 459-460.
[1] These heights above the canopy are equivalent to 0.45, 0.63, 0.85, 1.2, and 1.8 m above ground level (Appendix III, p. 455).

6. Air Sampling

Two pre-application samples were collected at 0.15 m and 0.33 m above the crop canopy at the approximate center of the test plot (Appendix I, p. 93). Samples were collected for *ca.* 6 hours on September 8, 2019.

Post-application in-field air samplers were used for flux monitoring for *ca.* 168 hours following application (Appendix I, p. 93). Samplers were placed on a mast in the approximate center of the plot directly following spray application at heights of 0.15, 0.33, 0.55, 0.90, and two at 1.5 m above the crop canopy. Samples were collected at *ca.* 6, 12, 24, 36, 48, 60, 72, 84, 96, 108, 120, 132, 144, 156, and 168 hours post-application. The 0 to 6-hour and 6 to 12-hour samples were pro-rated based on the time remaining until sunset on the day of application, with subsequent samples being collected on a morning (after sunrise)-evening (prior to sunset) schedule.

Off the plot, eight perimeter air monitoring stations were located 1.5 m above the crop canopy and 10 m outside the edge of the plot (Appendix I, p. 94). Samples were collected at *ca.* 1, 6, 12, 24, 36, 48, 60, 72, 84, 96, 108, 120, 132, 144, 156, and 168 hours post-application.

7. Spray Drift Monitoring

The spray drift test system consisted of three downwind transects, two left wind transects, two right wind transects, and two upwind transects. All transects were perpendicular to the edge of the field. Deposition collectors (Whatman #1 15 cm diameter filter papers) were placed on all transects at the following distances from the edge of the spray area: 3, 5, 10, 20, 40, 50, and 60 m. Deposition collectors were also placed at 90 m in the downwind transects only. Deposition collectors were secured to carboard squares and attached to a horizontal plastic platform at crop height (~12 in, 30.5 cm). Initial deposition samples were collected 19 to 46 minutes after spray application was completed. Deposition samples were collected at intervals of 1, 24, 48, 72, 96, 120, 144, and 168 hours post-application (Appendix I, p. 94).

8. Plant Effects Monitoring

The off-target movement of dicamba due to spray drift and volatility following the application of dicamba to soybeans that are dicamba tolerant was to be assessed by comparing plant heights and visual plant symptomology along transects of dicamba-non-tolerant soybean crop surrounding the tolerant soybean field and perpendicular to the sprayed field edges of the application area out to a maximum distance of approximately 90 meters. However, after planting on July 8th, but before test substance application, soybean displayed evidence of dicamba injuries (auxin-type). Soybeans were replanted on August 9th and auxin-type injuries were observed for a second time. Because dicamba injuries were present before test substance application, it was determined these injuries were not study related and plant effects (height and phytotoxicity) could not accurately be measured following test substance application (p. 11). As a result, the plant effects portion of the study was discontinued.

9. Sample Handling and Storage Stability

PUF sorbent tube and deposition filter paper samples were handled with clean nitrile gloves, which were replaced after the collection of samples and prior to installation of a new sample media for the next sampling interval (Appendix I, pp. 97). PUF sorbent tubes and filter papers were placed in pre-labeled conical tubes. Field volatility, spray drift, application monitoring, field exposed spikes, and transit samples were kept in frozen storage (coolers containing dry ice) prior to and during shipment to the analytical test site. Pre-application, application verification (in-swath), post-application, field exposed spikes, and transit stability PUF samples were stored in freezers prior to shipment, with the pre-application and application verification samples stored in separate freezers from the post application, field exposed spikes, and transit stability samples. Samples were hand delivered with dry ice, except for tank mix samples which were shipped ambient, to the analytical laboratory.

All field collected PUF and filter paper samples were extracted within 23 and 27 days, respectively, after collection (p. 30). All field exposed QC and transit stability samples were

analyzed within 28 days after sampling. All PUF and filter paper samples were analyzed within 10 and 4 days, respectively, after extraction. Freezer storage studies were conducted previously (MRIDs 50102117 and 50102118) demonstrating storage stability of at least 90 and 115 days for PUF and filter paper samples, respectively.

10. Analytical Methodology

- Sampling Procedure and Trapping Material: Flux monitoring equipment consisted of polyurethane foam (PUF) sampling tubes (SKC Cat. No. 226-92) and SKC® air sampling pumps (Model Nos. 224-44XR, 224-43XR, 224-PCXR3, 224-PCXR4, and 224-PCXR7; Appendix I, p. 93). The pumps were powered by 12-volt batteries and protected from precipitation by ¾ inch diameter PVC pipes and plastic bags. Pumps were calibrated to a flow rate of 3.0 L/min.

- Extraction method: PUF samplers were extracted and analyzed using Monsanto method ME-1902-02 with modifications (p. 28, Appendix II, p. 227). The contents of the PUF sorbent tubes were extracted using methanol containing stable-labeled internal standard. The samples were agitated on a high-speed shaker for extraction. An aliquot was filtered, evaporated to dryness, and reconstituted in 25% methanol in water. The sample was analyzed by LC-MS/MS with electrospray ionization in negative ion mode.

  Filter paper samplers were extracted and analyzed using Monsanto method ME-1871-01 with modifications (p. 27, Appendix II, p. 228). The filter paper samples were extracted using 25% methanol in water solution in the presence of stable-labeled internal standard. The sample tubes were capped and agitated on a high-speed shaker for extraction. An aliquot of the supernatant was filtered, and then dicamba was quantitated using LC-MS/MS with electrospray ionization in negative ion mode.

- Method validation (Including LOD and LOQ): Method validation was achieved by fortifying three samples each at fortification levels of 1 ng/PUF, 10 ng/PUF, and 100 ng/PUF (p. 16; Appendix II, pp. 230-231). Validation assessments showed acceptable accuracy between 70% and 120% and precision (<20% RSD) for all fortified matrices at each fortification level. The mean overall recovery of the nine fortification samples was 107%. Mean recoveries were 114% ± 4.5%, 101% ± 4.5%, and 105% ± 2.4%, for the fortification levels of 1 ng/PUF, 10 ng/PUF, and 100 ng/PUF, respectively. No independent laboratory validation is provided. The LOD was 0.3 ng/PUF and the LOQ was 1.0 ng/PUF (p. 28; Appendix II, p. 223).

  Method validation was achieved by fortifying three samples each at fortification levels of 0.005 µg/filter paper, 0.05 µg/filter paper, and 0.5 µg/filter paper (p. 16, Appendix II, pp. 232). Validation assessments showed acceptable accuracy between 70% and 120% and precision (<20% RSD) for all fortified matrices at each fortification level. The mean overall recovery of the nine fortification samples was 107%. Mean recoveries were 103% ± 5.5%, 108% ± 1.6%, and 109% ± 2.4% for fortification levels of 0.005 µg/filter paper, 0.05 µg/filter paper, and 0.5 µg/filter paper, respectively. Values were corrected for average control

response. No independent laboratory validation is provided. The LOD was 0.0015 ng/filter paper and the LOQ was 0.005 µg/filter paper (p. 28; Appendix II, p. 223).

- Instrument performance: Concentrations at which calibration standards for PUFs were prepared are not reported numerically. An example calibration curve indicates calibration standards were prepare at concentrations ranging from *ca.* 0.3 to 75 ng/PUF (Appendix II, Appendix 10, p. 384). Analyst software was used to derive the calibration curve using a weighted linear curve (1/x; Appendix II, p. 305).

  Concentrations at which calibration standards for filter paper samples were prepared are not reported numerically. An example calibration curve indicates calibration standards were prepare at concentrations ranging from ca. 0.0015 to 6 µg/filter (Appendix II, Appendix 11, p. 411). Analyst software was used to derive the calibration curve using a weighted quadratic curve (ax^2+bx+c; Appendix II, p. 416).

11. Quality Control for Air Sampling

Lab Recovery:	20 of 24 laboratory spike recoveries are within the acceptable range of 90-110% (Appendix II, Table 8, p. 244). All laboratory spike recoveries are within the range of 68-110%. Laboratory spike samples were prepared at fortification levels of 1.00 ng/PUF (12 samples) and 60.0 ng/PUF (12 samples). Average recoveries were 94% and 101% at 1.00 ng/PUF and 60.0 ng/PUF, respectively.
Field blanks:	Two six-hour pre-application samples were collected from the center of the test plot on September 8, 2019, the day before application (Appendix I, p. 93). Dicamba was detected in one of the two pre-application samples at 0.37 ng/PUF (Appendix II, Table 9, p. 245). The level detected was less than the LOQ (1.0 ng/PUF). All six control samples from field spike analyses contained no detectable dicamba (Appendix II, Table 11, p. 252).
Field Recovery:	Nine 6-hour and nine 12-hour field spike samples were collected at concentration levels of 3, 10, and 30 ng/PUF. A total of six field spikes were prepared at each concentration level. Most field spike recoveries are within the acceptable range with overall recoveries of 90% to 106% at 3 ng/PUF, 97% to 104% at 10 ng/PUF, and 100% to 113% at 30 ng/PUF (Appendix II, p. 231 and Appendix II, Table 11, p. 252).
Travel Recovery:	Two sets of three transit stability PUF samples were fortified at 3 and 30 ng/PUF, stored, and shipped frozen to the analytical laboratory (Appendix II, pp. 231-232). The range of recoveries from the fortified samples was from 75% to 100% at 3 ng/PUF and 100% to 103% at 30 ng/PUF (Appendix II, Table 12, p. 253).

Breakthrough: Laboratory spike samples that were fortified at 60 ng/PUF had recoveries ranging from 92% to 108% (Appendix II, Table 8, p. 244). The highest dicamba amount measured on a PUF sample (excluding laboratory and field spikes) was 29.3 ng/PUF (Appendix II, Tables 9-10, pp. 245-251) which is *ca.* 49% of the highest fortification level, indicating that dicamba loss due to breakthrough is unlikely.

12. Quality Control for Deposition Sampling

Lab Recovery: 43 of 60 laboratory spike recoveries are within the acceptable range of 90-110%. All laboratory spike recoveries are within the range of 89-125%. Laboratory spike samples were prepared at fortification levels of 0.005 µg/filter (27 samples), 5 µg/filter (27 samples), and 50 µg/filter (6 samples). Average recoveries were 102%, 105%, and 119% at 0.005, 5, and 50 µg/filter, respectively. Control samples from the field spike analysis did not contain detectable levels of dicamba (Appendix II, p. 255-257).

Travel Recovery: Ten transit stability filter paper samples were fortified at 0.01 and 0.05 µg/filter paper and placed on dry ice (Appendix II, p. 277). The range of recoveries from the fortified samples was from 97% to 109%.

13. Application Verification

Twelve application monitoring samples consisting of four filter paper samples each were positioned in the spray area in locations to capture various portions of the spray boom (Appendix I, pp. 92-93). The mean recovery relative to the target was 89% (Appendix II, p. 229).

Variable flow rate technology was used to adjust sprayer output ensuring sprayer output at the target rate of 15.0 GPA (Appendix I, p. 92). Pass times were not used to calculate an application rate.

Tank mix samples were also collected and analyzed to verify the amount of dicamba present in the tank mix (Appendix I, p. 92).

14. Deposition and Air Concentration Modeling

Off-target air concentrations and deposition were calculated for the test plot based on the calculated flux rates and relevant meteorological data. U.S. EPA's AERMOD model (version 19191) was used to estimate air concentrations and deposition (Appendix III, pp. 456-457). A second set of air concentration estimates was made for a hypothetical 200-acre application using the Probabilistic Exposure and Risk model for Fumigants (PERFUM, version 3). PERFUM modeling was performed using three different meteorological data sets, from Raleigh, North Carolina; Peoria, Illinois; and Lubbock, Texas.

The reviewer chose the maximum flux predicted by any method for each period to represent that period. Periods were then mapped onto hours of the day (1- 24), where the maximum flux rate for each hour was then chosen to represent that hour, regardless of the day from which it was collected. In cases where two periods occurred in a single hour, a weighted average of the flux rates was used. The 24-hour flux profile for the first two days were used as inputs for PERFUM and the average flux rate and as adjustment factors for input into AERMOD. The study authors used the flux rates from the aerodynamic method, so they were slightly different from those the reviewer used. However, the differences in flux rates did not impact the overall modeling conclusions.

Air concentration and dry deposition estimates were made at distances from the field every 5 m from 5 to 90 m using AERMOD (Appendix III, pp. 471-473). Study authors used the flux rates obtained using the aerodynamic method in the modeling. The highest modeled 24-hour dry deposition at a distance of 5 m was 2.040 $\mu g/m^2$, occurring during the first 24 hours after application (Appendix III, Table 7, p. 475). Wet deposition was not modeled because no precipitation occurred during the study.

PERFUM modeling calculated off-target air concentrations for a 200-acre field based on historical meteorological data (Appendix III, pp. 457, 476). Modeled dicamba air concentrations were calculated at distances of 5, 10, 25, 50, and 90 m from the field. Modeled 95th percentile 24-hour average air concentrations ranged from 4.7 to 10 ng/m^3 at 5 m from the edge of the treated field and 2.1 to 6.0 ng/m^3 at 90 m from the edge of the field (pp. 17-18 and Appendix III, Table 10, p. 479).

The reviewer was able to confirm the modeling conclusions for the deposition concentrations. Reviewer estimated air concentration values were slightly higher (14-22 ng/m^3) based on a higher flux rate during the evening hours. The reviewer also conducted modeling analysis for Little Rock, Arkansas, Nashville, Tennessee, and Springfield, Missouri, attempting to capture modeling results representative of soybean growing regions in Arkansas, Tennessee, and Missouri. Modeled 95th percentile 24-hour air concentrations were slightly higher (19-38 ng/m3), but comparable, than those achieved for the North Carolina, Illinois, and Texas modeling results.

II. Results and Discussion

A. Empirical Flux Determination Method Description and Applicability

Indirect Method

The indirect method, commonly referred to as the "back calculation" method, was the technique employed for estimating flux rates from fields treated for this field study given the available data. In the indirect method, air samples are collected at various locations outside the boundaries of a treated field. Meteorological conditions, including air temperature, wind speed, and wind direction, are also collected for the duration of the sampling event. The dimensions and orientation of the treated field, the location of the samplers, and the meteorological information are used in combination with the AERMOD dispersion model (Version 18081) and a unit flux rate of 0.001 g/m^2·s to estimate concentrations at the sampler locations. Since there is a linear

relationship between flux and the concentration at a given location, the results from the AERMOD model runs are compared to those concentrations actually measured, and a regression is performed, using the modeled values along the x-axis and the measured values along the y-axis. If the linear regression does not result in a statistically significant relationship, the regression may be rerun forcing the intercept through the origin, or the ratio of averages between the monitored to modeled concentrations may be computed, removing the spatial relationship of the concentrations. The indirect method flux back calculation procedure is described in detail in Johnson et al., 1999.

Study authors used a similar analysis to obtain flux rates. Initially a linear regression analysis was conducted by forcing the intercept through zero and the slope was used to estimate the flux rate. The slopes for all periods were significant, so no further refinements to the process were needed.

Aerodynamic Method

The aerodynamic method, also referred to as the "flux-gradient" method, was the technique employed for estimating flux rates from fields treated for this field study given the available data. In the aerodynamic method, a mast is erected in the middle of the treated field and concentration samples are typically collected at four or five different heights, ranging from 0.5 to 10 feet. Likewise, temperature and wind speed data are collected at a variety of heights. A log-linear regression is performed relating the natural logarithm of the sample height to the concentration, temperature, and wind speed. These relationships are then incorporated into an equation to estimate flux. The methods to estimate flux and related equations are presented in Majewski et al., 1990. The equation for estimating flux using the aerodynamic method is Thornthwaite-Holzman Equation, which is shown in the following expression:

Equation 1
$$P = \frac{k^2(\Delta\bar{c})(\Delta\bar{u})}{\phi_m\phi_p[\ln\left(\frac{z_2}{z_1}\right)]^2}$$

where P is the flux in units of $\mu g/m^2 \cdot s$, k is the von Karman's constant (dimensionless ~0.4), $\Delta\bar{c}$ is the vertical gradient pesticide residue concentration in air in units of $\mu g/m^3$ between heights z_{top} and z_{bottom} in units of meters, $\Delta\bar{u}$ is the vertical gradient wind speed in units of m/s between heights z_{top} and z_{bottom}, and ϕ_m and ϕ_p are the momentum and vapor stability correction terms respectively. Following the conditions expected in the neutrally stable internal boundary layer characterized by an absence of convective (buoyant) mixing but mechanical mixing due to wind shear and frictional drag, a log-linear regression is performed relating the natural logarithm of the sample height to the concentration, temperature, and wind speed. The adjusted values of the concentration, temperature, and wind speed from this regression is incorporated into Equation 1 to arrive at Equation 2 which is ultimately used to compute the flux.

Equation 2
$$Flux = \frac{-(0.42)^2(c_{ztop} - c_{zbottom})(u_{ztop} - u_{zbottom})}{\phi_m\phi_p \ln\left(\frac{z_{top}}{z_{bottom}}\right)^2}$$

where ϕ_m and ϕ_p are internal boundary layer (IBL)stability correction terms determined according to the following conditions based on the calculation of the Richardson number, R_i:

Equation 3 $$R_i = \frac{(9.8)(z_{top} - z_{bottom})(T_{ztop} - T_{zbottom})}{\left[\left(\frac{T_{ztop} + T_{zbottom}}{2}\right) + 273.16\right] + \left(u_{ztop} - u_{zbottom}\right)^2}$$

where T_{ztop} and $T_{zbottom}$ are the regressed temperatures at the top and bottom of the vertical profile in units of °C.

if $R_i > 0$ (for Stagnant/Stable IBL)

$\phi_m = (1 + 16R_i)^{0.33}$ and $\phi_p = 0.885(1 + 34R_i)^{0.4}$

if $R_i < 0$ (for Convective/Unstable IBL)

$\phi_m = (1 - 16R_i)^{-0.33}$ and $\phi_p = 0.885(1 - 22R_i)^{-0.4}$

The minimum fetch requirement that the fetch is 100 times the highest height of the air sampler for this method to be valid was not satisfied at for any of the sampling periods. Average fetch distances ranged from 143 to 159 m, while the minimum fetch distance was 180 m (the highest height of the samplers was 1.5 m, 1.5 m above the crop canopy of 0.3 m). As a result, there is some uncertainty in whether the plume was completely captured and in the resulting flux rates. The aerodynamic method used to estimate flux and related equations are presented in Majewski et al., 1990.

Integrated Horizontal Flux Method

The integrated horizontal flux method, also referred to as the "mass balance" method, was the technique employed for estimating flux rates from fields treated for this field study given the available data. In the integrated horizontal flux method, a mast is erected in the middle of the treated field and concentration samples are typically collected at four or five different heights, ranging from approximately 0.5 to 5 feet. Likewise, wind speed data are collected at a variety of heights. A log-linear regression is performed relating the natural logarithm of the sample height to the air concentration and wind speed following the log law relationships for the atmospheric boundary layer. These relationships are then incorporated into an equation to estimate flux. The methods to estimate flux and related equations are presented in Majewski et al., 1990. The equation for estimating flux using the integrated horizontal flux method is the following expression:

Equation 4 $$P = \frac{1}{x}\int_{Z_0}^{Z_p} \bar{c}\,\bar{u}\,dz$$

where P is the volatile flux in units of $\mu g/m^2 \cdot s$, $\bar{c}$ is the average pesticide residue concentration in units of $\mu g/m^3$ at height Z in units of meters, $\bar{u}$ is the wind speed in units of m/s at height Z, x is the fetch of the air trajectory blowing across the field in units of meters, Z_0 is the aerodynamic surface roughness length in units of meters, Z_p is the height of the plume top in units of meters,

and dz is the depth of an incremental layer in units of meters. Following trapezoidal integration, equation 3 is simplified as follows in equation 5 (Yates, 1996):

Equation 5 $$P = \frac{1}{x}\sum_{Z_0}^{Z_P}(A * Ln(z) + B) * (C * Ln(z) + D)dz$$

where A is the slope of the wind speed regression line by ln(z), B is the intercept of the wind speed regression line by ln(z), C is the slope of the concentration regression by ln(z), D is the intercept of the concentration regression by ln(z), z is the height above ground level. Z_p can be determined from the following equation:

Equation 6 $$Z_P = \exp\left[\frac{(0.1 - D)}{C}\right]$$

The minimum fetch requirement of 20 meters for this method to be valid was satisfied at all times. The surface roughness length was below the maximum surface roughness requirement of 0.1 meters for roughly half of the monitoring periods, with all but three periods below a surface roughness of 0.14 meters. The surface roughness length for the remaining monitoring periods ranged from 0.16 to 0.17, adding uncertainty to the flux rates that were estimated. All of the periods with surface roughness values above 0.1 meters occurred overnight.

B. Temporal Flux Profile

The flux determined from the registrant and reviewer for each sampling period after the application is provided in **Tables 6** and **7**. The pH of the tank mix was 4.8.

Table 6. Field volatilization flux rates of dicamba obtained in study – Indirect Method

Sampling Period	Date/ Time	Sampling Duration (hours)	Flux Estimate			
			Reviewer ($\mu g/m^2 \cdot s$)	Notes	Registrant ($\mu g/m^2 \cdot s$)	Notes
1	9/9/19 10:06 – 14:09	4.05	0.000738	Regression, no intercept	0.000760	
2	9/9/19 14:12 – 17:07	2.92	0.001232	Regression, no intercept	0.001239	
3	9/9/19-9/10/19 17:09 – 8:44	15.58	0.000068	Regression	0.000054	
4	9/10/19 8:47 – 17:03	8.27	0.000596	Regression	0.000689	
5	9/10/19-9/11/19 17:07 – 8:37	15.50	0.000019	Regression, no intercept	0.000019	
6	9/11/19 8:39 – 17:03	8.40	0.000782	Regression, no intercept	0.000794	
7	9/11/19-9/12/19 17:06 – 8:36	15.50	0.000019	Regression	0.000025	
8	9/12/19 8:38 – 16:58	8.33	0.000342	Regression	0.000440	

Sampling Period	Date/ Time	Sampling Duration (hours)	Flux Estimate			
			Reviewer ($\mu g/m^2 \cdot s$)	Notes	Registrant ($\mu g/m^2 \cdot s$)	Notes
9	9/12/19-9/13/19 17:01 – 8:35	15.57	0.000018	Regression, no intercept	0.000018	
10	9/13/19 8:35 – 17:11	8.60	0.000176	Regression, no intercept	0.000172	
11	9/13/19-9/14/19 17:16 – 8:39	15.38	0.000015	Regression, no intercept	0.000015	
12	9/14/19 8:41 – 16:56	8.25	0.000080	Regression, no intercept	0.000083	
13	9/14/19-9/15/19 16:59 – 8:33	15.57	0.000005	Regression, no intercept	0.000005	
14	9/15/19 8:35 – 17:02	8.45	0.000106	Regression, no intercept	0.000106	
15	9/15/19-9/16/19 17:05 – 8:30	15.42	0.000007	Regression	0.000011	

Data obtained from Appendix III, Table 2-3, pp. 464-465 of the study report.
Sample durations calculated by reviewer in 128931_50958202_DER-FATE_835.8100_4-23-20_Calc.xlsx.

Table 7. Field volatilization flux rates of dicamba obtained in study – Integrated Horizontal Flux and Aerodynamic Methods

Sampling Period	Date/ Time	Sampling Duration (hours)	Flux Estimate			
			Reviewer ($\mu g/m^2 \cdot s$)	Registrant ($\mu g/m^2 \cdot s$)	Empirical Flux Determination Method*	Notes
1	9/9/19 10:07 – 14:10	4.0	0.000550 0.002203	0.001026 0.001448	IHF AD	
2	9/9/19 14:13 – 17:07	2.9	0.000921 0.002453	0.000827 0.002493	IHF AD	
3	9/9/19-9/10/19 17:09 – 8:39	15.5	0.000070 0.000079	0.000063 0.000077	IHF AD	
4	9/10/19 8:42 – 17:02	8.4	0.000367 0.001061	0.000333 0.001076	IHF AD	
5	9/10/19-9/11/19 17:05 – 8:35	15.6	0.000063 0.000018	0.000042 0.000018	IHF AD	
6	9/11/19 8:37 – 17:01	8.4	0.000390 0.000884	0.000343 0.000894	IHF AD	
7	9/11/19-9/12/19 17:05 – 8:34	15.6	0.000425 0.000009	0.000352 0.000009	IHF AD	
8	9/12/19 8:35 – 16:57	8.4	0.000311 0.000509	0.000271 0.000519	IHF AD	
9	9/12/19-9/13/19 17:01 – 8:33	15.6	0.000019 0.000032	0.000014 0.000031	IHF AD	
10	9/13/19 8:36 – 17:03	8.5	0.000144 0.000393	0.000133 0.000395	IHF AD	

Sampling Period	Date/ Time	Sampling Duration (hours)	Flux Estimate			
			Reviewer ($\mu g/m^2 \cdot s$)	Registrant ($\mu g/m^2 \cdot s$)	Empirical Flux Determination Method*	Notes
11	9/13/19-9/14/19 17:06 – 8:38	15.6	0.000015 0.000035	0.000009 0.000034	IHF AD	
12	9/14/19 8:40 – 16:57	8.3	0.000049 0.000156	0.000033 0.000160	IHF AD	
13	9/14/19-9/15/19 17:01 – 8:32	15.6	0.000006 0.000011	0.000003 0.000011	IHF AD	
14	9/15/19 8:34 – 17:03	8.5	0.000058 0.000347	0.000049 0.000354	IHF AD	
15	9/15/19-9/16/19 17:06 – 8:32	15.5	0.000007 0.000011	0.000005 0.000011	IHF AD	

Data obtained from Appendix III, Table 4, p. 468 of the study report.
*Methods legend: AD = Aerodynamic Method, IHF = Integrated Horizontal Flux.

The maximum flux rate calculated by the indirect method occurred during the second sampling period after application during the afternoon hours. The study authors estimated the maximum flux rate of 0.001239 $\mu g/m^2 \cdot s$ (Appendix III, Table 3, p. 465). The study authors estimated the maximum flux rate for the aerodynamic method, 0.002493 $\mu g/m^2 \cdot s$, which also occurred during the second period after application (Appendix III, Table 4, p. 468). The study authors estimated the maximum flux for the integrated horizontal flux method, 0.001026 $\mu g/m^2 \cdot s$, which occurred during the first period after application. Reviewer estimated flux rates were similar to those derived by the study authors, except for the first period using the aerodynamic and integrated horizontal flux methods, as the study authors removed the sample collected at the 0.15 m height as an outlier, while the reviewer felt the concentration followed the trend of decreasing concentrations with increasing sampler height. As such, the reviewer estimated the maximum flux for the integrated horizontal flux method, 0.000921 $\mu g/m^2 \cdot s$, which occurred during the second period after application.

Study authors estimate r-squared values for the linear regressions of modeled and measured air concentrations in the indirect method ranged from 0.619 to 0.961 (Appendix III, p. 486). All but three of the r-squared values were $\geq$0.794. The three periods with low r-squared values occurred overnight.

R-squared values in log-linear vertical profiles of wind speed for the integrated horizontal flux and aerodynamic methods were all greater than 0.98. R-squared values in log-linear vertical profiles of concentration for the integrated horizontal flux and aerodynamic methods were all greater than 0.80 except for Periods 4 (0.64) and 7 (0.27). R-squared values in log-linear vertical profiles of temperature for the aerodynamic method were all greater than 0.95.

C. Spray Drift Measurements

Spray drift measurements indicated that dicamba residues were not detected above the no observed adverse effect concentration (NOAEC) for soybeans ($2.6x10^{-4}$ lb ae/A, or a deposition fraction of $5.2x10^{-4}$) in any of the upwind or left wind samples during the hour after application. Dicamba was detected at a maximum fraction of the applied deposition of 0.00133 in downwind samples (Table 1, pp. 44-49). Dicamba was detected at a maximum fraction of the applied deposition of 0.0111 in right wind samples (Table 4, pp. 58-61).

To develop the deposition curves for the downwind transects, data were fit to a modified Morgan-Mercer-Floden function, similar to how spray drift deposition estimates were derived for the AgDRIFT, ground application model.

$$f = \frac{1}{(1 + ad)^b}$$

where f is the fraction of the application rate at distance d (m). The fitted parameters are a and b, where a is the 'slope' parameter and b is the curvature of the function. Typically, the fitted equation would include a term to account for the deposition from each swath. However, as the path of application was not always perpendicular to the deposition collectors, this term was removed from the equation. The coefficients were obtained by fitting the field data for the various transects.

The reviewer estimated a distance from the edge of the field to reach NOAEC for soybeans ($2.6x10^{-4}$ lb ae/A, or a deposition fraction of $5.2x10^{-4}$) of 3.5 (1 to 4.8 m for the three transects) and 10.6 m (4.5 to 17 m for the two transects) in the downwind and right wind directions, respectively, for the first hour after application. The study authors did not perform fits of spray drift data, determining that they would not be useful due to the low levels of dicamba mass detected in the majority of samples (p. 34).

D. Plant Effects Measurements

Plant effects data were not collected due to non-study related dicamba injuries to soybean plants prior to test substance application.

III. Study Deficiencies and Reviewer's Comments

1. The soybean plot was originally planted on July 8, 2019 (Appendix I, pp. 80-81). Due to plant injury symptomatic of dicamba damage, the field was replanted on August 9, 2019. Injuries symptomatic of dicamba damage were again observed. For this reason, the plant effects study was not performed. Given the repeated incidents of injury, it is uncertain if additional incidents occurred after the application, confounding the flux rate estimates.

2. The study was conducted in compliance with U.S. EPA Good Laboratory Practice requirements with exceptions related to statistical analysis, test site information, study

weather data, pesticide and crop history, soil information, test plot preparation and maintenance, pH meter maintenance, and sprayer maintenance (p. 3).

3. Applications were made to soybean plants at the R1 stage, when the label indicates that applications should not occur after the V4 stage. Additionally, applications were made 36 inches above the plant canopy, while the label specifies that applications should not occur more than 24 inches above the target. It is not believed that either of these deficiencies adversely impacted the study.

4. Study authors do not provide an explanation for why one measurement of dicamba deposition exceeding the NOAEC at 10 m from the plot, 72-hours after application in the downwind direction (Table 1, p. 46).

5. The first air monitoring period started after the conclusion of application.

6. Analytical method validation was performed, but the method was not independently validated. A method validation study should be completed from an independent laboratory separate from and prior to the analysis of the test samples to verify the analytical methods.

7. Soil was characterized (Appendix I, p. 85 and Appendix I, Table 2, p. 105), but no taxonomic classification was provided.

8. Soil bulk density and organic matter content were reported but at only a single depth of 0-6 inches.

Study Deficiencies: Plant Effects

1. Plant effects, including height and phytotoxicity observations, were not measured due to symptoms of dicamba (auxin-type) injuries on dicamba-non-tolerant soybeans in the test plots prior to the application of the test substance. Test plots were replanted with dicamba-non-tolerant soybeans, but auxin-type injuries were once again observed on the stand. Following these observations, the collection of plant effect data was terminated because the study authors determined "the apparent injuries observed compromised/confounded the ability to generate any meaningful plant effects assessment data" (p. 18). Because no plant effects were measured, statistical analyses could not be performed and NOEAD (No Observed Adverse Effect Distance) and ED_{25} (Effect Distance causing ≥25% significant effect) values could not be determined.

   Note, a separate yield study (TK0475489), concurrently conducted approximately 1,200 ft from this off-target field study was also terminated due to repeated plant injuries similar to plant injuries observed in this study prior to test application.

2. The GSG 4914 variety of soybean that was planted in the test plots for both the volatility and spray drift study, is a dicamba-non-tolerant soybean. This variety was also selected

because of its glyphosate-tolerance. It is uncertain if this genetically modified variety may have impacted dicamba effects compared to a non-genetically modified variety.

3. Due to planting late in the season, plants flowered sooner due to warmer temperatures, so the test substance was applied to plants in the R1 growth stage. OSCPP guidance states the test substance should be applied between the two- and four-leaf stage.

4. Soybean was the only species used in this study; OCSPP guidance recommends testing at least 4 monocots and 6 dicots.

5. The study author did not provide historical germination rates for the soybean varieties planted.

6. The control plot was placed upwind of the treatment field. The specific distance upwind from the edge of the field was not reported.

7. The physico-chemical properties of the test material were not reported.

8. The P48A60X variety of soybean that was planted in the test plots for both the volatility and spray drift study, is a non-Dicamba tolerant soybean. This variety was also selected because of its glyphosate-tolerance. It is uncertain if this genetically modified variety may have impacted dicamba effects compared to a non-genetically modified variety.

IV. **References**

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Wilson, J.D., and Shum. W.K.N. 1992. A re-examination of the integrated horizontal flux method for estimating volatilisation from circular plots. Agriculture Forest Meteor. Vol 57:281-295.

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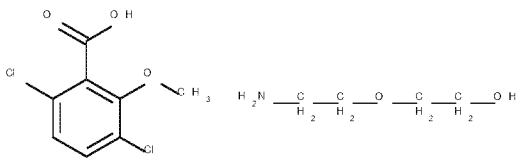
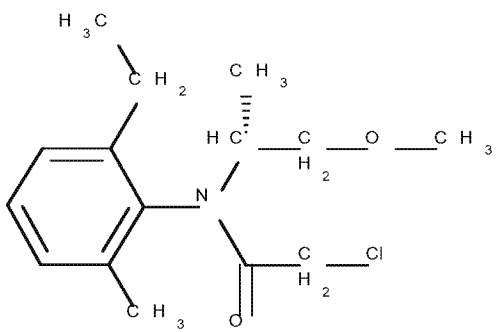
Attachment 1: Chemical Names and Structures

Dicamba-diglycolamine and S-metolachlor and Its Environmental Transformation Products. [A]

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (study length)
PARENT						
Dicamba-diglycolamine (Diglycolamine salt of dicamba)	IUPAC: 3,6-Dichloro-o-anisic acid-2-(2-aminoethoxy)ethanol CAS: 2-(2-Aminoethoxy)ethanol;3,6-dichloro-2-methoxy-benzoic acid CAS No.: 104040-79-1 Formula: $C_{12}H_{17}Cl_2NO_5$ MW: 326.17 g/mol SMILES: COc1c(Cl)ccc(Cl)c1C(=O)O.NCCOCCO		835.8100 Field volatility	50958202	NA	NA
S-metolachlor	IUPAC: 2-Chloro-N-(6-ethyl-o-tolyl)-N-[(1S)-2-methoxy-1-methylethyl]acetamide CAS: 2-Chloro-N-(2-ethyl-6-methylphenyl)-N-[(1S)-2-methoxy-1-methylethyl]acetamide CAS No.: 87392-12-9 Formula: $C_{15}H_{22}ClNO_2$ MW: 283.8 g/mol SMILES: Cc1cccc(CC)c1N(C(=O)CCl)C(C)COC					
MAJOR (>10%) TRANSFORMATION PRODUCTS						

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (study length)
No major transformation products were identified.						
MINOR (<10%) TRANSFORMATION PRODUCTS						
No minor transformation products were identified.						
REFERENCE COMPOUNDS NOT IDENTIFIED						
All compounds used as reference compounds were identified.						

Attachment 2: Statistics Spreadsheets and Graphs

Supporting spreadsheet files accompany the review.

1. Air sampling periods and soil temperature and moisture graphs

128931_50958202_DE
R-FATE_835.8100_5-29

2. Validation spreadsheet for the Indirect Method

128931_50958202_DE
R-FATE_835.8100_5-29

3. Validation spreadsheet for the Integrated Horizontal Flux Method:

128931_50958202_DE
R-FATE_835.8100_5-29

4. Validation spreadsheet for the Aerodynamic Method:

128931_50958202_DE
R-FATE_835.8100_5-29

5. Air modeling files

128931 50958202 air modeling.zip

6. Validation spreadsheet for spray drift calculations

128931_50958202_DE
R-Fate_840.1200_8-29

Attachment 3: Field Volatility Study Design and Plot Map

Figure obtained from Appendix I, Figure 2, p. 118 of the study report.